清華大學
Tsinghua University

清华大学高等研究院 - 冷原子物理系列讲座

Ultracold Fermions

地点: 高等研究院，科学馆三楼报告厅

报告人: Professor Joseph H. Thywissen
University of Toronto

Lecture 1: Building Blocks of a Quantum Simulator

May 14 (Monday) 2018 10:30 a.m.

Many-body physics has long been the domain of materials and quantum liquids, in which interactions between fermions produce interesting and useful phenomena. However, connecting emergent properties to microscopic understanding is stymied by complexity, impurities, and unknown coupling strengths. Ultracold atoms offer a "bottom up" approach to similar problems, enabling the experimental realization of a quantum simulator.

Lecture 2: Universality in Spin Transport

May 16 (Wednesday) 2018 10:30 a.m.

The evolution of trapped ultracold samples is coherent, and typically with sufficiently slow intrinsic time scales that non-equilibrium dynamics can be controlled and observed. Experimental studies of demagnetization through spin transport address an open question: How fast can local equilibrium be established? In the strongly interacting regime, we find evidence for a lower bound on spin diffusivity.

Lecture 3: Matter Waves in Crystals of Light

May 16 (Wednesday) 2018 3:30 p.m.

The periodic potential experienced by electrons in crystalline materials can be recreated for neutral atoms through standing waves of laser light. We discuss the pioneering experiments with nanokelvin atoms loaded into optical lattices, including Bloch oscillations, the effect of a trap, control over lattice structure, and in-situ thermometry.

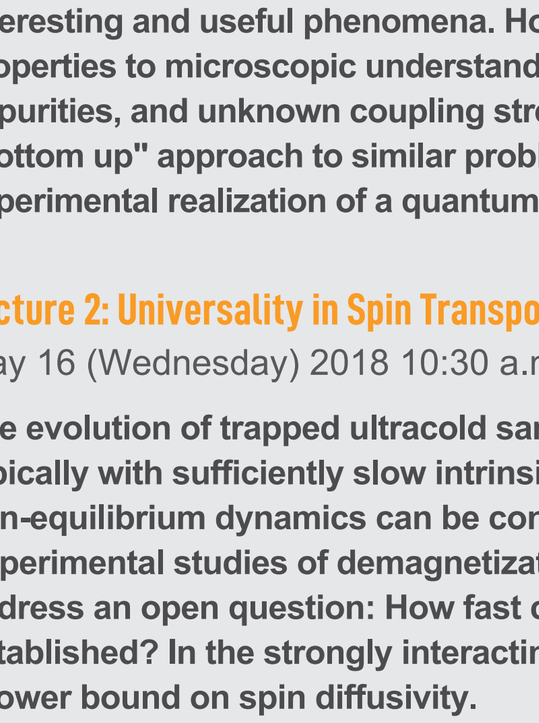
Lecture 4: Quantum Simulations of the Hubbard Model

May 17 (Thursday) 2018 10:30 a.m.

The Hubbard model gives a minimalist paradigm for interacting fermions in a crystal. In some situations, atoms in optical lattices are well described by this model, and have been used to explore its phase diagram. We discuss how the equivalent of metals, Mott Insulators, band insulators, and anti-ferromagnets have been observed in groups around the world. A new generation of quantum gas microscopes has enabled the direct observation of the order parameter for insulating and magnetic phases.

Lecture 5: Conductivity of Ultracold Fermions in Optical Lattices

May 17 (Thursday) 2018 3:30 p.m.



Transport measurements of materials has proven to be a powerful tool for discovery. In this lecture, we discuss how to measure the ac (or "optical") conductivity of neutral atoms in a lattice. Exact sum rules apply to conductivity spectra. The width of the response is a measure of the finite transport lifetime, limited by atom-atom collisions. We compare ab-initio calculations to measurements of conductivity with independent control of lattice depth, temperature, filling, and interaction strength.

Professor Joseph H. Thywissen

Joseph H. Thywissen is a Professor of Physics, and a Senior Fellow of Massey College, at the University of Toronto. He received his undergraduate degree from Harvey Mudd College in 1994; a doctoral degree from Harvard in 2000; and pursued postdoctoral studies in the group of Alain Aspect at the Institut d'Optique, France. In 2003, Dr. Thywissen joined the University of Toronto as a Canada Research Chair. He is now a Fellow of the Canadian Institute for Advanced Research, and a Fellow of the American Physical Society.